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Company: **United States Patent and Trademark Office**
Assistant Commissioner for Patents
Washington D.C. 20231

Re: **Warren S. SLUTTER et al.**
U.S. Patent Application No. 09/998,002 Filed: November 30, 2001
Attorney Docket No. SLUTTER-RE Confirmation No. 7237
"MODIFIED CONCENTRIC SPECTROGRAPH"

FROM: **Roger Pitt, Patent Agent**
DATE: **April 25, 2003**


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COMMENTS

Please see the accompanying pages.

Respectfully submitted,


Anthony H. Handal
Reg. No. 26,275
Roger Pitt
Reg. No. 46,996

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BOX REISSUE

Assistant Commissioner of Patents
Washington, D.C. 20231

TECHNOLOGY CENTER 2800

Re: Warren S. SLUTTER

U.S. Patent Application No. 09/998,002 Filed: November 30, 2001
Attorney Docket No. SLUTTER-RE Confirmation No. 7237
(Reissue of U.S. Patent No. 5,995,221 Dated: November 30, 1999)
"MODIFIED CONCENTRIC SPECTROGRAPH"

SIR:

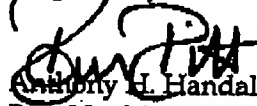
We enclose herewith:

- [X] Request for Issuance of a Revised Office Action;
- [X] Copy of Second Preliminary Amendment Dated May 22, 2002;
- [X] Copy of Information Disclosure Statement submitted May 22, 2002
(further copies of references not included);
- [X] Copies of two (2) acknowledgment postcards date-stamped June 6, 2002
by the OPIE.

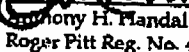
The Commissioner is hereby authorized to charge payment of the fees associated with future communications or credit any overpayment to Deposit Account No. 08-0570.

Applicant hereby petitions under 37 CFR 1.136 or other applicable rule to have the response period extended the number of months necessary to render the attached communication timely if a petition is required.

Respectfully submitted,


Anthony H. Handal
Reg. No. 26,275
✓ Roger Pitt
Reg. No. 46,996

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Anthony H. Handal Reg. No. 26,275
Roger Pitt Reg. No. 46,996

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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In re application of : Attorney Docket No.:
SLUTTER-RE
Applicant: Warren S. SLUTTER et al. : GAU: 2876
Application No.: 09/998,002 :
Filed: November 30, 2001 : Examiner: L. Lauchman
For: "MODIFIED CONCENTRIC :
SPECTROGRAPH"
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Assistant Commissioner for Patents
Washington, D.C. 20231

April 25, 2003

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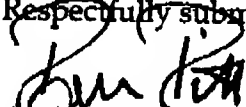
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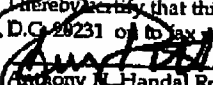
REQUEST FOR ISSUANCE OF A REVISED OFFICE ACTION

Applicant notes with appreciation the Examiner's allowance of Claims 1-14 and 66 in the Office Action dated April 8, 2003. However, unfortunately, the action does not address applicant's second preliminary amendment or information disclosure statement, both submitted on May 22, 2002 (copies herewith). The Office is respectfully requested to issue a revised Office Action to take account of these papers. The Examiner is invited to call the undersigned if she believes a telephone interview will advance prosecution of the application.

Respectfully submitted,


Anthony H. Handal
Reg. No. 26,275
Roger Pitt
Reg. No. 46,996

I hereby certify that this correspondence is being FACSIMILE transmitted to the Assistant Commissioner for Patents, Washington, D.C. 20231 on to fax no. (703) 872-9318 April 25, 2003


Anthony H. Handal Reg. No. 26,275
Roger Pitt Reg. No. 46,996

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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| In re application of | : | Attorney Docket |
| | : | No.: SLUTTER-RE |
| Applicant: SLUTTER et al. | : | |
| Application No.: 09/998,002 | : | |
| Reissue of Patent No. 5,995,221 | : | GAU: Unknown |
| | : | |
| Filed: November 30, 2001 | : | Examiner: Unknown |
| | : | |
| For: "MODIFIED CONCENTRIC | : | |
| SPECTROGRAPH" | : | |
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SECOND PRELIMINARY AMENDMENT**S I R:**

Prior to examination, please make the following amendments:

IN THE CLAIMS:

Please CANCEL claims 2-6, 9 and 13-14.

Please AMEND claims 1, 7, 11-12 and 66 to read as follows:

1. (twice amended) A concentric spectrograph comprising:

a diffraction grating having an optical axis, a meridian plane, and a grooved
concave surface and a set of parallel grating grooves on said concave surface,
said meridian plane containing the grating optical axis and extending

perpendicularly to the parallel grooves;

a field lens having a planar surface, a convex surface; and an optical axis, wherein said lens convex surface faces and is concentric with said grating concave surface, said optical axes of said grating and said lens are coincident and said planar surface extends perpendicularly to said lens optical axis;

an entrance port to introduce incident polychromatic light to the lens planar surface at a location on said lens planar surface out of said meridian plane and on said one side of said meridian plane; and

an exit port located to receive a non-zero order of diffracted light emerging from said lens planar surface at a location out of said meridian plane on the other side of the meridian plane from the incident light, without significant mixing with adjacent orders of diffracted light.

7. (amended) The spectrograph of claim 1 wherein said entrance port and said exit port are located at the same perpendicular distances from said meridian plane.

8. (amended) The spectrograph of claim 1 further comprising a housing enclosing the grating and lens for ~~preventing~~ reducing stray light contamination.

11. (amended) The spectrograph of claim 1 further comprising a reflective surface between said entrance port or said exit port and said lens.

12. (amended) The spectrograph of claim 11 wherein said reflective surface is planar and has an axis normal to said reflective surface, said axis forming an angle with said grating optical axis, said angle optionally being about 45 degrees.

Please ADD new claims 84-119, as follows:

84. (new) A concentric spectrograph according to claim 1 wherein the exit port is located to receive first order diffracted light, optionally negative first order diffracted light, without significant mixing with second order diffracted light and wherein the first order diffracted light is received without significant mixing with zero order reflected light.

85. (new) A concentric spectrograph according to claim 1 wherein the entire cross-sectional area of each entrance or exit port is located to receive said non-zero order of diffracted light without receiving light from other diffracted orders.

86. (new) A concentric spectrograph according to claim 1 wherein the entire cross-sectional area of each entrance or exit port is located at a distance from the meridian plane.

87. (new) A concentric spectrograph according to claim 1 wherein the grating is a

reflective holographic grating.

88. (new) A concentric spectrograph according to claim 1 wherein the exit port has an elongated shape, optionally a rectangular shape, having a longitudinal axis that is parallel to the meridian plane.

89. (new) A concentric spectrograph according to claim 88 wherein the entrance port has a symmetrical shape, optionally an elongated rectangle, and a small size.

90. (new) A concentric spectrograph according to claim 1 wherein the convex lens surface and the concave grating surface are spherical surfaces.

91. (new) A concentric spectrograph according to claim 1 wherein the spectrograph has a focal plane and at least one of the entrance and exit ports faces the lens planar surface and is near the focal plane.

92. (new) A concentric spectrograph according to claim 1 comprising a housing formed from an optically opaque material to prevent stray light from entering the housing and wherein the concave grating, the field lens and the entrance and exit ports are mounted in the housing.

93. (new) A concentric spectrograph according to claim 1 adapted for incident polychromatic light comprising light of wavelength of from about 350 nm to about 800 nm.

94. (new) A concentric spectrograph according to claim 1 comprising multiple pairs of entrance and exit ports.

95. (new) A concentric spectrograph according to claim 1 wherein the spectrograph comprises at least two said entrance ports and at least two said exit ports, the entrance being paired to the exit ports so that light incident at one of the entrance ports of a pair is received by the exit port of the respective pair.

96. (new) A concentric spectrograph according to claim 95 wherein the entrance ports are each located on the one side of the meridian plane and the exit ports are each located on the other side of the meridian plane.

97. (new) A concentric spectrograph according to claim 95 comprising two entrance ports located on respective opposed sides of the meridian plane, the two exit ports also being located on respective opposed sides of the meridian plane.

98. (new) A concentric spectrograph according to claim 1 wherein the grating concave

surface and the field lens convex surface are spherical wherein the ratio of the radius of curvature of the convex lens to the radius of curvature of the concave lens is about 0.4:1 (column 11, lines 46-49) and wherein the spacing between the convex lens surface and the concave grating surface is about 0.6 times the grating radius of curvature.

99. (new) A concentric spectrograph according to claim 1 wherein the grating concave surface is spherical with a radius of curvature of about 250 mm and a diameter of about 130 mm, the field lens convex surface is also spherical and has a radius of curvature of about 94 mm and a diameter of about 110 mm, the distance between the grating concave surface and the lens convex surface is about 155 mm and the spectrograph has an F-number of about 1.3.

100. (new) A concentric spectrograph according to claim 1 wherein the spectrograph entrance and exit ports are positioned near a focal plane of the spectrograph and the optical path lengths at the ports are similar.

101. (new) A concentric spectrograph according to claim 100 comprising a reflective surface in the optical path adjacent the entrance port or the exit port, or both, to move the focal plane at the respective port.

102. (new) A concentric spectrograph according to claim 101 comprising a prism

providing said reflective surface wherein a portion of the field lens in the respective optical path has a reduced thickness to preserve the optical path length at the respective port.

103. (new) A concentric spectrograph according to claim 1 wherein input light is incident upon the grating at a non-perpendicular angle, incident light fills the grating area and diffracted incident light is receivable at the exit port from all the filled grating area.

104. (new) A concentric spectrograph according to claim 1 wherein the entrance and exit ports are laterally displaced on opposite sides of a plane through the optical axis and parallel with the grating lines, being a plane perpendicular to the meridian plane.

105. (new) A method according to claim 66 wherein the entrance and exit ports are each located at a distance from the meridian plane in opposite directions from the meridian plane, the distances being the same (*claim 46, lines 48-49 and claim 51*) and wherein the exit port is located to receive the order of light without mixing with adjacent orders of diffracted light, the received order being the negative first order.

106. (new) A method for diffracting two beams of light employing a concentric spectrographic apparatus, the apparatus including a grating, a lens, a primary entrance

port, a primary exit port, a secondary entrance port and a secondary exit port, the method comprising the elements of:

- a) providing a first polychromatic light beam to the primary entrance port;
- b) refracting the first light beam with the lens to diverge the beam toward the grating;
- c) reflectively diffracting the first light beam at the grating to form a first diffracted beam;
- d) imaging the first diffracted light beam with the lens at the primary exit port;
- e) providing a second polychromatic light beam to the secondary entrance port;
- f) refracting the second light beam with the lens to diverge the beam toward the grating;
- c) reflectively diffracting the second light beam at the grating to form a second diffracted beam; and
- d) imaging the second diffracted light beam with the lens at the secondary exit port.

107. (new) A method according to claim 106 wherein elements e) - f) are performed during the performance of elements a) - d).

108. (new) A method according to claim 106 wherein performance of elements e) - f) is alternated with performance of elements a) - d).

109. (new) A method according to claim 106 wherein the first and second polychromatic light beams are each provided to the lens at respective lens locations displaced from the meridian plane.
110. (new) A method according to claim 106 wherein the first and second diffracted light beams are each received from the lens at respective locations displaced from the meridian plane.
111. (new) A modified concentric spectrograph comprising:
- a grating having an optical axis, a meridian plane, and a concave surface, said meridian plane having a first side and a second side;
 - a lens having a substantially planar surface, a convex surface, and an optical axis, wherein said convex surface is facing said concave surface, said optical axes being substantially coaxial;
 - a primary entrance port being located substantially out of said meridian plane toward said first side; and
 - a primary exit port being located substantially out of said meridian plane toward said second side for receiving an order of light that maximizes throughput and minimizes astigmatism.
112. (new) A modified concentric spectrograph comprising:

a grating having an optical axis, a meridian plane, and a concave surface;
a lens having a substantially planar surface, a convex surface, and an optical axis,
wherein said convex surface is facing said concave surface, said lens optical axis
is substantially coaxial with said grating optical axis, and a primary focal plane is
formed perpendicular to said optical axis facing said planar surface of said lens;
a primary entrance port near said primary focal plane at an intersection between a
first axis and a second axis, wherein said first axis is parallel to, and offset in a
first direction from, said meridian plane and said second axis is perpendicular to
said meridian plane and offset from said optical axis; and
a primary exit port near said primary focal plane located at a second perpendicular
distance from said meridian plane, in a second direction opposite said first
direction for receiving an order of light that maximizes throughput and
minimizes astigmatism.

113. (new) The spectrograph of claim 112 wherein the primary exit port is located for
receiving a negative first order of diffracted light.

114. (new) The spectrograph of claim 112 wherein said exit port is elongated along said
first axis.

115. (new) The spectrograph of claim 112 wherein said entrance port is for receiving

light from a primary light source, said spectrograph further comprising a housing for preventing light coming from a secondary light source external to said housing from contaminating said light from said primary source in said housing.

116. (new) The spectrograph of claim 112 further comprising:

- a secondary entrance port; and
- a reflective surface between said primary entrance port and said lens, wherein said reflective surface forms a modified focal plane in which said secondary entrance port is located.

117. (new) A modified concentric spectrograph comprising:

- a grating having an optical axis, a meridian plane, and a concave surface;
- a lens having a substantially planar surface, a convex surface, and an optical axis, wherein said convex surface is facing said concave surface, said optical axes are substantially collinear and said surfaces are substantially concentric, and a primary focal plane is formed perpendicular to said optical axis facing said planar surface of said lens;
- a primary entrance port near said primary focal plane at an intersection between a first primary axis and a second primary axis, wherein said first primary axis is parallel to and offset from said meridian plane and said second primary axis is perpendicular to said meridian plane and offset from said grating optical axis;

- a primary exit port near said primary focal plane located at a first perpendicular distance from said meridian plane, said first perpendicular distance being in a second direction opposite said first direction for receiving an order of light that maximizes throughput and minimizes astigmatism;
- a secondary entrance port near said primary focal plane at an intersection between a first secondary axis and a second secondary axis, wherein said first secondary axis is parallel to and offset from said meridian plane and said second secondary axis is perpendicular to said meridian plane and offset from said grating optical axis; and
- a secondary exit port near said primary focal plane located at a second perpendicular distance from said meridian plane in said second direction.

118. (new) The spectrograph of claim 117 wherein said non-zero order is a negative first order.

118. (new) The spectrograph of claim 117 wherein said primary entrance port is for receiving light from a primary light source, said spectrograph further comprising a housing around in which said grating and said lens is placed.

119. (new) The spectrograph of claim 117 wherein at least one of said ports is in said primary focal plane.

REMARKS

The Preliminary Amendment filed November 30, 2001, requested the Office to amend claim 66 and provided a marked-up amended version of claim 66. Any inconvenience to the Office is sincerely regretted. However, owing to clerical oversight, no clean copy of amended claim 66 was also provided. This minor oversight is rectified herewith by the filing of an amended claim 66 in proper form. The marked-up version of claim 66 filed November 30, 2001 is superseded by the version filed herewith which differs from the earlier version so that no clean copy of the November 30, 2001 version appears necessary.

In this amendment, claims 2-6, 9 and 13-14 are canceled and claims 1, 7, 11-12 and 66 are amended. New claims 84-119 are added particularly pointing out and distinctly claiming the subject matter of the invention.

The Invention of Claim 1

The invention as now claimed in amended claim 1 provides a concentric spectrograph comprising a concave diffraction grating and a coaxial convex field lens having planar and convex surfaces. The convex surface faces and is concentric with the grating concave surface. The spectrograph has an entrance port to introduce incident polychromatic light to the field lens at a location on the planar surface of the lens which is out of the meridian plane of the grating and on one side of the meridian plane. The

meridian plane is a plane containing the grating optical axis and extending perpendicularly to the grating grooves. An exit port is located to receive a desired order of diffracted light emerging from the lens planar surface at a location out of the meridian plane on the other side of the meridian plane from the incident light, without significant mixing with adjacent orders of diffracted light.

In use, the grating, as is well known in the art, diffracts incident light into a number of spatially dispersed orders. The exit port is positioned to receive a desired order, for example, the negative first order which is preferred for its intensity and closeness to the optical axis. In conventional concentric spectrographs, where light is introduced to and collected from the lens planar surface, at locations on the meridian plane, significant stray light problems occur.

The present invention identifies one source of these problems as being contamination of the output image with scattered light from adjacent diffraction orders that may reach the exit port traveling along indirect paths within the instrument. The invention recognizes, for the first time, that portions of the diffracted light orders can reflect back from the convex lens surface toward the diffraction grating where they will undergo a second diffraction. In conventional concentric spectrographs, this twice-diffracted light may reach the exit port.

By offsetting both the location of incidence from the entrance port and the location of emergence of the diffracted light to the exit port, as defined in amended claim 1, the invention enables this twice-diffracted stray light to be rejected.

WO 90/02928 ("Lobb")

A reference cited in a search report received on a counterpart European application, Sira Ltd.'s international publication WO 90/02928, inventor Lobb, ("Lobb" herein after) discloses an imaging spectrometer useful, for example, for scanning the Earth's surface (*last complete paragraph on page 2 of the specification*). Figs. 1, 2 and 4 of the drawings are orthogonal to the grating lines and apparently include the optical axis. Accordingly, Figs. 1, 2 and 4 are meridian plane views. Fig. 4 is a modified embodiment. Fig. 3 is a view parallel to the grating lines, i.e. perpendicular to Figs. 1-2 and 4.

The structure of the device shown in Figs. 1-3 is described at page 5 line 4 to page 6, line 7 from the bottom. Relevant description of the alternative embodiment of Fig. 4 appears at page 10, line 3 from the bottom to page 11, line 8. Stray light rejection is discussed at page 12, line 20 to page 14, line 4.

The Lobb spectrometer comprises an entrance aperture 116, a planoconvex field lens, called a refracting corrector 104, which receives light incident at entrance aperture

116, and a concave reflecting diffraction grating 106 facing the convex surface of corrector 104. Light received by diffraction grating 106 from corrector 104 is output to an image or spectrum plane 112 through an unlabeled exit port shown only in Fig. 1. The convex surface of corrector 104 and the concave surface of grating 106 are concentric with a center of curvature at or near the spectrum plane 112 (*page 6, lines 10-13 and 6-8*) where the image is received by an instrument such as an area array detector 114.

Lobb's entrance aperture 116 is shown as traversing the meridian plane and the optical axis in Fig. 1. In Fig. 3, when read with the description at page 6, paragraph 4, the entrance aperture can be seen to be longitudinally extended on either side of the spectrometer optical axis, parallel to the grating lines. In Fig. 4 the entrance aperture, in object plane 104, is rotated through 90°, by means of a prism 400, to separate the object plane 102 from the spectrum (image) plane 112. The Fig. 4 entrance aperture may be understood from Fig. 3 to be longitudinally extended, parallel to the grating lines, on either side of the meridian plane. The meridian plane is, in Fig. 3, the plane perpendicular to the paper on the optical axis 210. In Fig. 4., the meridian plane is the plane of the paper. The entrance aperture can be slit-shaped or comprise two or more slits (*page 7, 3 lines from bottom to page 8, line 1*).

For optimal results, Lobb places the center of the entrance aperture at the center

of curvature of grating 106 and the convex surface of corrector 104 (*page 9, last three lines*). This is the point referenced 202 in Fig. 2. Since the center of curvature lies on the optical axis and the meridian plane, the entrance aperture is in optimal configurations these entities are be symmetrically centered in the entrance aperture.

Clearly, Lobb's spectrometer does not meet the requirements of applicant's amended claim 1 that the entrance port should introduce incident polychromatic light to the lens planar surface at a location on the lens planar surface *out of* the meridian plane on the one side of the meridian plane. For this reason alone, the invention of amended claim 1 is clearly and patentably distinguished from Lobb.

Lobb's exit port, or image plane 112, Figs. 3 and 4, is also extended on either side of the spectrometer optical axis, parallel to the grating lines. Therefore, Lobb's spectrometer furthermore does not meet the requirements of applicant's amended claim 1 that the exit port should receive diffracted light from the lens planar surface at a location on the lens planar surface *out of* the meridian plane on the other side of the meridian plane. The invention of amended claim 1 is further clearly and patentably distinguished from Lobb for this additional reason.

Nor does Lobb's spectrometer meet the requirement of amended claim 1 that the exit port receive an order of diffracted light without significant mixing with adjacent

orders. Lobb takes no steps to this end and the extended area exit port required to deliver light to image plane 112, as shown in Lobb's drawings, clearly will not discriminate one diffraction order from others. This is because image plane 112 extends along the meridian plane, in a direction transverse to the grating lines, in a position where multiple diffraction orders will be received. The invention of amended claim 1 is still further clearly and patentably distinguished from Lobb for this additional reason.

Not surprisingly, with its extended entrance and exit ports, Lobb's spectrograph suffers from significant stray light problems. These are discussed at page 12, line 20 to page 13, line 11 and include scatter from optical surfaces and reflections from the detector. As discussed in more detail in applicant's specification (*e.g.* at column 2, lines 3-8 and column 8, lines 8-67), and avoided by applicant's invention, light reaching the convex surface of corrector lens 104 can be reflected back to grating 106 and further diffracted whereupon second order and other images can be received at the exit port, contaminating the image.

Lobb's stray light difficulties are such as to require the complication of complementary ghost image removal by signal processing (*page 13, lines 22-25*), success of which is predicated upon employing a slit-shaped entrance aperture at the optical axis (*page 13, lines 17-18*). In view of the uncertainty of this measure, the utility of which is dependent upon the quality of the ghost image, Lobb also proposes the more drastic

measure of using only one side of the grating to avoid back diffraction of reflections from the detector surface (*page 13, line 26 to page 14, line 4*) to the exit port. In addition to its other drawbacks, This measure complicates the device, reduces the intensity of the output image and may not be effective for rejection of twice-diffracted second order images.

Clearly, Lobb does not remotely suggest applicant's spectrograph as claimed in amended claim 1 which elegantly solves stray light problems by offsetting both the entrance port and the exit port from the meridian plane and by positioning the exit port to receive one order of diffracted light without significant mixing with adjacent orders. Lobb neither recognizes that twice-diffracted second order light may contaminate a first order image, nor provides a solution to the problem.

By offsetting the entrance and exit apertures, and taking the other measures set forth in amended claim 1, applicant avoids introducing light normal to the grating. Consequently, the grating can be fully illuminated, for optimal image intensity, while stray light problems are avoided.

Accordingly, applicant's invention, as now claimed in claim 1 is believed clearly and patentably distinguished from Lobb or any other reference known to applicant.

Furthermore, one skilled in the art will see that applicant's preferred embodiment, as shown in the drawings, is quite unlike Lobb's embodiments, with respect to the construction of the entrance and exit ports, and will therefore expect a different result to be obtained, as indeed it is. Thus, Lobb's preferred entrance port, slit 102, Figs. 3 and 4, extends for more than half the diameter of lens 104, as shown in Fig. 3. In contrast, applicant's preferred entrance port 205, 305, 405, 475 or 505, as consistently shown in Figs. 5-7 and 9-13, is quite small in relation to field lens 215, 315, 415 or the lens of Fig. 13.

Comparably, Lobb's preferred exit port, or image plane 112, as shown in Figs. 3 and 4, has a substantial, two-dimensional extent equivalent to a major portion of the right-hand half of lens 104, looking toward grating 106. Again in contrast, applicant's preferred exit port 211, 311, 411, 476, 505 or 575, as consistently shown in Figs. 5-7 and 9-13 of applicant's drawings, is also quite small in relation to field lens 215, 315, 415 or the lens of Fig. 13. Applicant's preferred exit port has a narrow elongated shape, is positioned to receive one diffraction order without mixing with others and is overall quite different from the much larger extended area exit port required by Lobb to receive exiting light into image area 112.

Lobb's slit 102 and image plane 112 would clearly be difficult, if not impossible to relocate in accordance with the requirements of amended claim 1, even were the art to

contain a suggestion to do same, which the art known to applicant does not.

Attempting to relocate slit 102 or image plane 112 to be on one or the other side of the meridian plane of Lobb's spectrograph would require changes not suggested and contrary to Lobb's objectives. Clearly, Lobb neither taught nor contemplated applicant's claimed invention or the benefits to be obtained therefrom.

Independent Claims 66, 106, 112 and 117

Independent claims 66, 106, 112 and 117 are also believed clearly and patentably distinguished from Lobb or any other reference known to applicant for reasons similar to those explained with regard to amended claim 1.

Dependent Claims

Claims 7-8, 11-12 and 84-105 depend either directly or indirectly from base claim 1, claims 107-110 depend from base claim 106, and claims 113-116 depend from base claim 112. Dependent claims 7-8, 11-12, 84-105, 107-110 and 113-116 are therefore believed allowable with their respective base claims for the reasons that the base claims are believed allowable. Dependent claims 7-8, 11-12, 84-105, 107-110 and 113-116 are furthermore clearly and patentably distinguished from the art of record, and therefore allowable, by the additional meaningful limitations they recite.

More particularly, claim 84 specifically recites that the exit port is located to

receive first order diffracted light without significant mixing with second order diffracted light or zero order reflected light, which is not remotely suggested by Lobb, or any of the art of record in the original application.

Claim 86 specifically recites that the entire cross-sectional area of each entrance or exit port is located at a distance from the meridian plane, which is not remotely suggested by Lobb, or any of the art of record in the original application.

Claim 94 clearly recites multiple pairs of entrance and exit ports, and claim 95 specifies that the spectrograph comprises at least two paired entrance and exit ports, neither of which subjects is shown or suggested by Lobb, or any of the art of record in the original application.

Moreover, Claim 103 specifically recites that input light is incident upon the grating at a non-perpendicular angle and that incident light fills the grating area. Claim 104 recites that the entrance and exit ports are laterally displaced on opposite sides of a plane perpendicular to the meridian plane neither of which subjects is shown or suggested by Lobb, or any of the art of record in the original application.

In view of the above amendments and the discussion relating thereto, it is

respectfully submitted that the instant application, as amended, is in condition for allowance. Such action is most earnestly solicited. If for any reason the Examiner feels that consultation with Applicant's representative would be helpful in the advancement of the prosecution, he is invited to call the telephone number below for an interview.

Respectfully submitted,

By:

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"VERSION WITH MARKINGS TO SHOW CHANGES MADE"

1. (twice amended) A concentric spectrograph comprising:

- a diffraction grating having an optical axis, a meridian plane, and a grooved concave surface and a set of parallel grating grooves on said concave surface, said meridian plane containing the grating optical axis; and extending perpendicularly to the parallel grooves ~~and having a first and second sides, the first side being a volume residing above the meridian plane and a the second side being a volume residing below the meridian plane;~~
- a field lens having a substantially planar surface, a convex surface; and an optical axis, wherein said lens convex surface faces and is concentric with said grating concave surface, and said optical axes of said grating and said lens are substantially coaxial or parallel coincident and said planar surface extends perpendicularly to said lens optical axis;
- ~~an entrance port located out of said meridian plane on said first side so that to~~ introduce incident polychromatic light is introduced to the lens planar surface at a location on said lens planar surface out of said meridian plane and on said first one side of said meridian plane; and
- ~~an exit port located to receive a non-zero order of diffracted light emerging from said lens planar surface at a location out of said meridian plane on said second the other side of the meridian plane from the incident light, for receiving one order of diffracted light without significant mixing with adjacent orders of~~

diffracted light.

7. (amended) The spectrograph of claim 1 wherein said ~~primary~~ entrance port and said ~~primary~~ exit port are located at ~~substantially~~ the same perpendicular distances from said meridian plane.

8. (amended) The spectrograph of claim 1 wherein:
~~said entrance port is for receiving polychromatic light from a source, said~~
~~spectrograph further comprising: a housing enclosing the grating and lens for~~
~~preventing reducing stray light from contaminating said polychromatic light in said~~
~~housing contamination.~~

11. (amended) The spectrograph of claim 1 further comprising a reflective surface between said ~~primary~~ entrance port or said exit port and said lens.

12. (amended) The spectrograph of claim 11 wherein said reflective surface is planar and has an axis normal to said reflective surface, said axis forming an angle with said grating optical axis, said angle optionally being about 45 degrees.

66. (amended) A method for dispersing light comprising:
passing polychromatic light through an entrance port located ~~substantially~~ on a first

side of and at a perpendicular distance from a meridian plane of a concave diffraction grating, said meridian plane containing the grating optical axis and extending perpendicularly to the parallel grooves;

directing said polychromatic light with a lens toward said grating so that said light is incident on said grating ~~at least at said meridian plane;~~

diffracting said light with said diffraction grating, thereby dispersing said light; and

imaging said dispersed light with said lens at an exit port located substantially on a second side of said meridian plane for receiving ~~an~~ a non-zero order of diffracted light ~~that maximizes throughput and minimizes astigmatism without significant mixing with adjacent orders of diffracted light.~~

Sheet 1 of 1

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